

THE TAXONOMIC VALUE OF TRICHOMES IN *PELARGONIUM* L'HÉRIT. (GERANIACEAE)

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ABSTRACT

A detailed study of the indumentum of the leaves of 133 *Pelargonium* species led to the classification of the trichomes into 11 different types: six non-glandular and five glandular hair types. The non-glandular hairs are uni- to multicellular and of different lengths, shape and wall thickness. Some hairs have a podium at the base. The glandular hairs consist of a uniserial stalk of various lengths and unicellular head of various shapes. The distribution of the various trichome and indumentum types in the different taxa of *Pelargonium* is discussed, especially where it can be of diagnostic value and serve as possible indication of relationships.

UITTREKSEL

DIÉ TAKSONOMIESE WAARDE VAN TRIGOME IN *PELARGONIUM* L'HÉRIT. (GERANIACEAE)

'n Volledige ondersoek van die indumentum van die blare van 133 *Pelargonium*-spesies het gelei tot die klassifikasie van die trigome in dié genus in 11 tipes: ses haartipes en vyf klierhaartipes. Die hare is een- tot veelsellig en varieer in lengte, vorm en wanddikte. Sommige hare het 'n podium by die basis. Die klierhare bestaan uit 'n uniseriale steel van verskillende lengtes en eensellige kop van verskillende vorme. Die verspreiding van die verskillende trigoom- en indumentumtipes in die verskillende taksa van *Pelargonium* word bespreek, veral waar dit van diagnostiese waarde kan wees en as moontlike aanduiding van verwantskappe kan dien.

Key words: *Pelargonium*, Geraniaceae, trichomes, diagnostic characters.

INTRODUCTION

Trichomes can be studied from two different perspectives: (1) the nature of the individual trichomes themselves, and (2) the characteristics which they collectively impart to the surfaces upon which they occur, i.e. the nature of the indumentum layer as a whole. Since the indumentum is not as

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much influenced by the structure of the individual trichomes as by their distribution and density, trichomes of rather different structure may give rise to similar indumentum types. It is also possible that the environment has a greater influence in modifying the indumentum than in changing the type of trichome (Johnson, 1975).

According to Carlquist (1961) trichomes often provide the taxonomist with the most important anatomical characters used in systematic comparisons. This is probably due to their variety, almost universal presence in angiosperms, simple preparation methods for studying, and close resemblance to patterns of variation in classification systems. In a taxonomic trichome study it is necessary to examine the whole trichome complement, and indicate the organographic distribution of the different trichome types as well.

The last comprehensive taxonomic revision of the genus *Pelargonium* was done by Knuth in 1912. It has become clear that his identification keys are unsatisfactory, and that some species are erroneously placed into sections. Since his revision, a number of new species have also been described. The genus includes more than 200 natural species of which the majority occur in southern Africa.

Phillips (1951), Willis (1973) and Van der Walt (1977) mention the fact that *Pelargonium* species are often conspicuously hairy and aromatic, and produce essential oils used in the perfume industry. Because trichome studies have already proved to be of taxonomic value in a number of taxa of various ranks, this study has been carried out as part of the extensive taxonomic project on *Pelargonium* in progress at the University of Stellenbosch.

The purpose of this study was to distinguish between, and classify, different trichome and indumentum types present in the genus, and to determine whether these types can be used as taxonomic characters in distinguishing between taxa, and in the determination of the possible phylogenetic relationships of these taxa.

MATERIAL AND METHODS

The petioles and laminae of 133 species and subspecies of *Pelargonium* were studied. The material was obtained from plants cultivated in the botanic garden of the University of Stellenbosch. In order to describe the type and density of the indumentum, the petioles and laminae were studied with the aid of a dissection microscope. Transverse sections were made of the above-mentioned organs in order to examine the structure of the individual trichomes. The figures presented in this paper are semi-schematic and drawn to scale.

trichomes as by their distribution. The structure may give rise to a different environment has a role in changing the type of

To provide the taxonomist with a systematic comparison, a universal presence in the genus, and close resemblance. In a taxonomic trichome complement, and different trichome types as

The genus *Pelargonium* has its identification keys previously placed into sections; also been described. In which the majority occur

1977) mention the fact that it is very aromatic, and very fragrant. Because trichomes are present in a number of taxa of the genus, the extensive taxonomic study of Stellenbosch.

to identify, and classify, differences, and to determine characters in distinguishing between different phylogenetic relationships.

Species of *Pelargonium* cultivated in the botanical garden to describe the type of trichomes. The trichomes were studied with a scanning electron microscope. The trichomes were made of the structure of the individual trichomes, schematic and drawn

Indumentum types

The following terminology has been used to describe the indumentum types in the different taxa of *Pelargonium*:

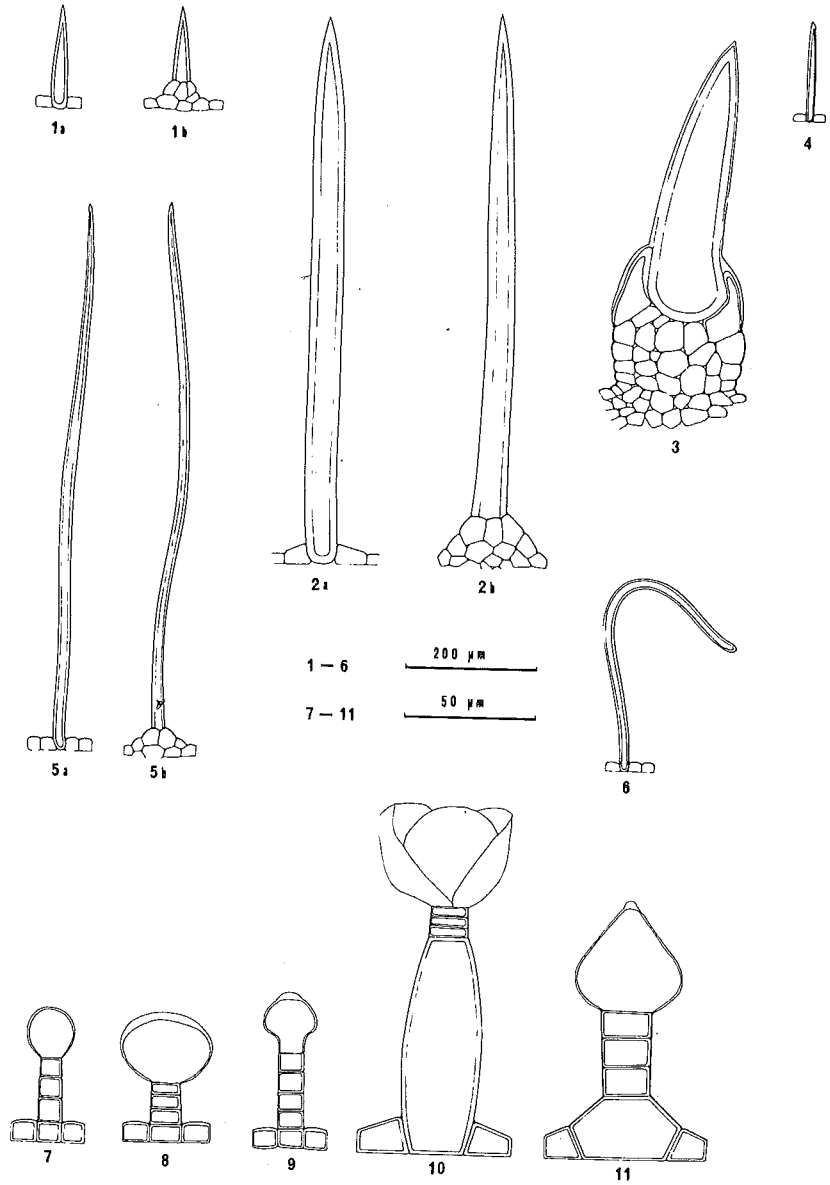
- ciliate: thin hairs, all of approximately the same length, on the margin of the leaf
- fimbriate: long, relatively thick, filamentous hairs on the margin of the leaf
- glabrous: without trichomes
- glandular: covered with glandular hairs
- hirsute: covered with long, straight, stiff hairs (not spiny) (hairs are thinner than in the case of a hispid indumentum)
- hirtellous (minutely hirsute): like hirsute, but with shorter hairs
- hispid: covered with long, straight, stiff, almost spiny hairs (hairs are thicker than in the case of a hirsute indumentum)
- lanate (woolly): covered with long, dense, entangled curly hairs – longer than in the case of a tomentose indumentum, and without a matted appearance
- pilose: covered with thin, soft hairs, longer than in the case of a pubescent indumentum
- pubescent: covered with short, thin, soft hairs
- setose (bristly): covered with very stiff, hard hairs (hairs are thicker and harder than in the case of a hispid indumentum)
- strigose: covered with stiff hairs with a sharp point, the hairs being appressed to the surface and orientated in a distal or proximal direction
- tomentose (densely woolly): covered with very dense, entangled, short hairs with a matted appearance
- velutinous: covered with very dense, straight, short hairs – appears velvety
- villous: covered with long, thin, soft hairs – not as dense as a tomentose indumentum, and without a matted appearance.

Density of indumentum

The following terms were used to describe the density of the indumentum (given in descending degree of density):

- dense (to very dense): epidermal cells are hardly visible
- relatively dense: trichomes are abundant
- scattered: trichomes are less abundant
- sparse (to almost glabrous): trichomes are scarce.

For each of the examined taxa the indumentum type and density were described in detail for the petiole, and ad- and abaxial sides of the lamina.



RESULTS

Trichome types

Only uni- and multicellular non-glandular hairs, and glandular hairs with a uniserial stalk (of various lengths) and unicellular head (of various shapes) occur in *Pelargonium* species. The length, thickness of the wall, shape (straight or curly) and presence of a podium served as criteria to classify the non-glandular hairs. (A podium is a multicellular structure, consisting of epidermal cells which are raised above the rest of the surface, and which surround the hair base, which is sunken into the podium.) With glandular hairs, the length of the stalk and shape of the glandular head and basal cell were used as characters of distinction. Due to the fact that transitional forms also occur, it is often difficult to classify such hairs. Glandular hairs, which are more closely connected to physiological processes in the plant, exhibit greater constancy of characters.

The following trichome types occur in the different taxa of *Pelargonium* (Fig. 1):

Type 1: short, straight, stiff hair; (a) without a podium; (b) with a podium.

Type 2: long, straight, stiff to almost spiny hair; (a) without a podium; (b) with a podium.

Type 3: very stiff, hard hair with a prominent podium.

Type 4: short, thin, soft hair.

Type 5: long, thin, soft hair; (a) without a podium; (b) with a podium.

Type 6: curly hair.

Type 7: short glandular hair with a small globular head, and stalk consisting of two to four cells.

Type 8: short glandular hair with a large globular head, and stalk consisting of one to four cells.

Type 9: short glandular hair with a small bulb-shaped head, and stalk consisting of two to five cells.

Type 10: relatively long to very long glandular hair with a globular or

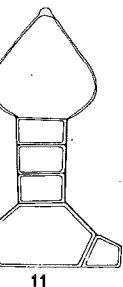
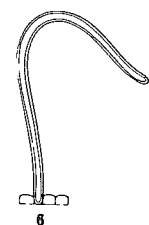
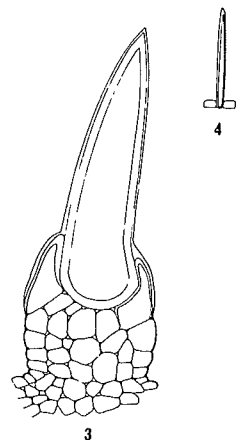


FIG. 1.

Trichome types occurring in *Pelargonium*. 1: Short, straight, stiff hair (a) without a podium, (b) with a podium. 2: Long, straight, stiff to spiny hair (a) without a podium, (b) with a podium. 3: Very stiff, hard hair with a prominent podium. 4: Short, thin, soft hair. 5: Long, thin, soft hair (a) without a podium, (b) with a podium. 6: Curly hair. 7: Short glandular hair with a small globular head, and stalk consisting of two to four cells. 8: Short glandular hair with a large globular head, and stalk consisting of one to four cells. 9: Short glandular hair with a small bulb-shaped head and stalk consisting of two to five cells. 10: Relatively long to very long glandular hair without a globular or bulb-shaped head, and stalk consisting of three to numerous cells of which the basal one is always elongated and often swollen. 11: Short glandular hair with a large pear-shaped head.

bulb-shaped head, and stalk consisting of three to numerous cells of which the basal one is always elongated and often swollen.

Type 11: short glandular hair with a large pear-shaped head.

A total of 11 trichome types have thus been distinguished: types 1 to 6 are non-glandular hair types, and 7 to 11 glandular hair types. Types 1, 2 and 4 have been subdivided on the ground of the presence of a podium surrounding the hair base. In many cases the sculpture of the hair surface also varies; a scanning electron microscopic study may therefore lead to a more detailed classification of trichome types.

Table 1 represents the occurrence of the different trichome types on the lamina and petiole of 133 taxa of *Pelargonium*. In the columns the trichome types are represented by their numbers (1 to 11) as indicated in Fig. 1. Every row contains the trichome types of a single species. The table is presented as illustration of how taxonomic conclusions could be drawn from this trichome study.

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TABLE	227-240
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as indicated in Fig. 1.
pecies. The table is pre-
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Page

227-240

TABLE 1

Occurrence of trichomes on the petiole and lamina of species of *Pelargonium*.
Trichome numbers refer to the types as indicated in Fig. 1. Unidentified species have
been given a project number, and are referred to as *P. species* (project number x).

Species	Petiole													
	Non-Glandular Hairs										Glandular Hairs			
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11
Section:														
<i>Hoarea</i>														
<i>P. auritum</i>														
-subsp. <i>auritum</i>	*	*		*						*				
-subsp. <i>carneum</i>	*	*		*						*				
<i>P. carneum</i>	*			*	*					*			*	
<i>P. incrassatum</i>				*		*				*			*	
<i>P. oblongatum</i>						*	*	*		*			*	
<i>P. pinnatum</i>	*			*						*			*	
<i>P. punctatum</i>	*			*						*			*	
<i>P. rapaceum</i>	*	*		*						*			*	
<i>P. spathulatum</i>														
<i>P. species (1571)</i>	*	*		*						*			*	
<i>P. species (2587)</i>	*	*		*						*			*	
<i>P. species (1613)</i>				*						*			*	
<i>P. species (442)</i>				*						*			*	
<i>P. species (2440)</i>	*		*	*						*			*	
<i>P. species (1456)</i>				*						*			*	
<i>P. species (1653)</i>	*		*	*						*			*	
<i>P. species (2439)</i>	*			*						*			*	
<i>P. species (2443)</i>	*	*		*						*			*	
<i>P. species (1454)</i>	*	*								*				
Section														
<i>Seymouria</i>														
<i>P. asarifolium</i>						*	*			*	*			
<i>P. dipetalum</i>			*							*				
<i>P. marginatum</i>				*						*				
<i>P. trifoliatum</i>	*			*						*				

Species	Lamina													
	Non-Glandular Hairs										Glandular Hairs			
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11
Section:														
<i>Hoarea</i>														
<i>P. auritum</i>														
-subsp. <i>auritum</i>				*						*	*		*	
-subsp. <i>carneum</i>				*						*	*			
<i>P. carneum</i>				*						*				
<i>P. incrassatum</i>				*		*	*			*	*		*	
<i>P. oblongatum</i>						*	*			*			*	
<i>P. pinnatum</i>		*		*						*			*	
<i>P. punctatum</i>	*			*						*			*	
<i>P. rapaceum</i>			*	*						*	*			
<i>P. spathulatum</i>			*							*				
<i>P. species (1571)</i>	*		*							*			*	
<i>P. species (2587)</i>			*	*						*				
<i>P. species (1613)</i>			*							*			*	
<i>P. species (442)</i>			*							*				
<i>P. species (2440)</i>			*							*			*	
<i>P. species (1456)</i>			*							*			*	
<i>P. species (1653)</i>	*		*							*			*	
<i>P. species (2439)</i>			*							*	*		*	
<i>P. species (2443)</i>			*							*			*	
<i>P. species (1454)</i>			*							*			*	
Section														
<i>Seymouria</i>														
<i>P. asarifolium</i> ✓									*	*	*			
<i>P. dipetalum</i>			*							*				
<i>P. marginatum</i>				*						*	*			
<i>P. trifoliatum</i>			*	*						*	*			

[illegible]

Species	Petiole														
	Non-Glandular Hairs									Glandular Hairs					
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11	
Section:															
<i>Polyactium</i>															
<i>P. anethifolium</i>	*									*					
<i>P. bowkeri</i>	*											*	*		
<i>P. caffrum</i>						*		*		*					
<i>P. flabellifolium</i>		*		*						*			*		
<i>P. heracleifolium</i>						*				*	*				
<i>P. lobatum</i>															
<i>P. luridum</i>		*		*						*			*		
<i>P. multiradiatum</i>	*	*								*					
<i>P. pillansii</i>	*			*						*					
<i>P. pulverulentum</i>										*					
<i>P. radulaefolium</i>						*	*			*		*	*		
<i>P. schizopetalum</i>										*		*			
<i>P. triste</i>			*	*						*			*		
<i>P. woodii</i>		*		*						*		*	*		
Section:															
<i>Otidia</i>															
<i>P. alternans</i>			*							*					
<i>P. carnosum</i>	*									*					
<i>P. ceratophyllum</i>	*									*					
<i>P. crithmifolium</i>	*									*					
<i>P. dasyphyllum</i>	*									*					

Species	Lamina													
	Non-Glandular Hairs									Glandular Hairs				
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11
Section:														
<i>Polyactium</i>														
<i>P. anethifolium</i>										*				
<i>P. bowkeri</i>	*		*							*			*	
<i>P. caffrum</i>							*			*				
<i>P. flabellifolium</i>				*						*			*	
<i>P. heracleifolium</i>			*							*	*	*		
<i>P. lobatum</i>	*	*			*					*				
<i>P. luridum</i>				*						*			*	
<i>P. multiradiatum</i>	*			*						*				
<i>P. pillansii</i>				*						*				
<i>P. pulverulentum</i>				*						*	*			
<i>P. radulaefolium</i>							*	*		*			*	
<i>P. schizopetalum</i>			*	*						*			*	
<i>P. triste</i>			*	*						*			*	
<i>P. woodii</i>			*							*			*	
Section:														
<i>Otidia</i>														
<i>P. alternans</i>			*	*						*				
<i>P. carnosum</i>			*	*						*			*	
<i>P. ceratophyllum</i>	*									*				
<i>P. crithmifolium</i>			*							*				
<i>P. dasyphyllum</i>	*									*				

Species	Petiole													
	Non-Glandular Hairs									Glandular Hairs				
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11
Section:														
<i>Ligularia</i>														
<i>P. abrotanifolium</i>						*					*		*	
<i>P. aridum</i>							*			*	*			
<i>P. artemisiaefolium</i>	*				*					*				
<i>P. articulatum</i>		*			*					*	*			
<i>P. dolomiticum</i>							*	*		*			*	
<i>P. exstipulatum</i>						*				*	*			
<i>P. fragile</i>	*				*					*				*
<i>P. grandicalcaratum</i>	*						*			*				
<i>P. hirtum</i>				*		*	*			*				
<i>P. hystrix</i>				*						*			*	
<i>P. ionidiflorum</i>				*		*				*			*	
<i>P. karooicum</i>	*									*	*			
<i>P. oreophilum</i>	*			*						*			*	
<i>P. ovato-stipulatum</i>					*					*		*	*	
<i>P. praemorsum</i>				*		*				*	*		*	
<i>P. pulchellum</i>				*		*				*			*	
<i>P. ramosissimum</i>	*				*			*		*				*
<i>P. sericifolium</i>			*							*	*			
<i>P. xerophyton</i>	*									*	*			
Section:														
<i>Jenkinsonia</i>														
<i>P. antidysentericum</i>	*						*					*	*	*
<i>P. tetragonum</i>	*	✓								*				

Species	Lamina													
	Non-Glandular Hairs									Glandular Hairs				
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11
Section:														
<i>Ligularia</i>														
<i>P. abrotanifolium</i>						*					*		*	
<i>P. aridum</i>				*						*				
<i>P. artemisiaefolium</i>				*	*					*				
<i>P. articulatum</i>				*						*				
<i>P. dolomiticum</i>	*				*	*	*			*			*	
<i>P. exstipulatum</i>						*					*			
<i>P. fragile</i>	*				*					*				*
<i>P. grandicalcaratum</i>			*							*	*			
<i>P. hirtum</i>	*			*						*				
<i>P. hystrix</i>				*						*			*	
<i>P. ionidiflorum</i>	*			*						*			*	
<i>P. karooicum</i>			*							*	*			
<i>P. oreophilum</i>	*			*						*	*		*	
<i>P. ovato-stipulatum</i>	*									*	*		*	
<i>P. praemorsum</i>	*									*	*			
<i>P. pulchellum</i>			*			*				*			*	
<i>P. ramosissimum</i>					*					*				*
<i>P. sericifolium</i>			*							*				
<i>P. xerophyton</i>	*									*				
Section:														
<i>Jenkinsonia</i>														
<i>P. antidysentericum</i>	*			*								*	*	*
<i>P. tetragonum</i>	*	*								*				

ina						
		Glandular Hairs				
5b	6	7	8	9	10	11
		*	*		*	
		*				
		*				
		*			*	
		*	*			*
		*				
		*	*		*	
		*	*		*	
		*	*		*	
		*			*	*
		*				
		*		*	*	*
		*				

Species	Petiole														
	Non-Glandular Hairs									Glandular Hairs					
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11	
Section:															
Myrrhidium															
P. candicans	*	*			*			*		*					
P. longicaule															
-subsp. angustipetalum	*			*						*					
-subsp. caucali-folium	*							*		*					
-subsp. convolvulifolium	*		*							*					
-subsp. longicaule	*									*		*			
P. multicaule															
-subsp. triangularare	*	*					*			*					
P. myrrhifolium															
-subsp. coriandri-folium	*	*		*						*					
-subsp. myrrhifolium	*	*		*	*					*				*	
P. suburbanum															
-subsp. bipinnatifidum							*		*	*					
-subsp. suburbanum									*	*					
Section:															
Peristera															
P. chamaedrifolium	*									*					
P. fumaroides	*									*					
P. grossularoides										*					
P. harveyanum	*			*						*			*		
P. iocastum	*									*					

Species	Lamina														
	Non-Glandular Hairs										Glandular Hairs				
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11	
Section:															
<i>Myrrhidium</i>															
<i>P. candicans</i>			*							*					
<i>P. longicaule</i>															
-subsp. <i>angusti-</i>															
<i>petalum</i>	*			*						*					
-subsp. <i>caucali-</i>															
<i>folium</i>	*									*					
-subsp. <i>convol-</i>															
<i>vulifolium</i>	*		*							*					
-subsp. <i>longicaule</i>	*									*					
<i>P. multicaule</i>															
-subsp. <i>trian-</i>															
<i>gulare</i>	*	*					*			*					
<i>P. myrrhifolium</i>															
-subsp. <i>coriandri-</i>															
<i>folium</i>	*	*			*					*					
-subsp. <i>myrrhi-</i>															
<i>folium</i>	*	*			*					*				*	
<i>P. suburbanum</i>															
-subsp. <i>bipinnati-</i>															
<i>fidum</i>	*		*		*		*		*	*					
-subsp. <i>suburba-</i>															
<i>num</i>	*			*					*	*					
Section:															
<i>Peristera</i>															
<i>P. chamaedrifolium</i>	*									*					
<i>P. fumaroides</i>	*									*					
<i>P. grossularoides</i>	*									*					
<i>P. harveyanum</i>	*			*						*			*		
<i>P. iocastum</i>	*		*							*					

		Glandular Hairs				
5b	6	7	8	9	10	11
		*				
		*				
		*				
		*				
		*				
		*				
		*				*
	*	*				
	*	*				
		*			*	
		*				
		*				
		*				
		*				

Species	Petiole													
	Non-Glandular Hairs									Glandular Hairs				
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11
Section:														
<i>Campylia</i>														
<i>P. caespitosum</i>														
-subsp. <i>caespitosum</i>						*				*	*		*	
-subsp. <i>concauum</i>	*									*				
<i>P. capillare</i>			*	*						*				
<i>P. coronopifolium</i>														
-subsp. <i>angustissimum</i>	*									*				
-subsp. <i>coronopifolium</i>	*									*				
<i>P. elegans</i>	*			*						*				
<i>P. oenotherae</i>	*		*	*						*				
<i>P. ovale</i>	*		*							*				
<i>P. tricolor</i>	*		*							*				
Section:														
<i>Dibrachya</i>														
<i>P. lateripes</i>				*			*			*				
<i>P. peltatum</i>			*				*			*				
Section:														
<i>Eumorpha</i>														
<i>P. alchemilloides</i>			*							*				
<i>P. elongatum</i>				*	*		*			*			*	
<i>P. grandiflorum</i>					*					*				
<i>P. patulum</i>	*				*					*				
<i>P. quinquilobatum</i>				*						*				
<i>P. tabulare</i>	*				*					*				
<i>P. transvaalense</i>							*			*			*	

Species	Lamina														
	Non-Glandular Hairs									Glandular Hairs					
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11	
Section: <i>Campylia</i>															
<i>P. caespitosum</i>															
-subsp. <i>caespitosum</i>			*												
-subsp. <i>concavum</i>	*									*		*	*		
<i>P. capillare</i>			*	*						*					
<i>P. coronopifolium</i>															
-subsp. <i>angustissimum</i>	*										*				
-subsp. <i>coronopifolium</i>	*										*				
<i>P. elegans</i>	*			*						*		*			
<i>P. oenotherae</i>		*	*							*			*		
<i>P. ovale</i>	*									*					
<i>P. tricolor</i>	*	*								*					
Section: <i>Dibrachya</i>															
<i>P. lateripes</i>	*														
<i>P. peltatum</i>			*							*					
Section: <i>Eumorpha</i>															
<i>P. alchemilloides</i>			*	*						*					
<i>P. elongatum</i>			*		*					*					
<i>P. grandiflorum</i>	*									*					
<i>P. patulum</i>	*				*					*					
<i>P. quinquelobatum</i>				*						*					
<i>P. tabulare</i>	*				*					*					
<i>P. transvaalense</i>			*							*					

mina						
		Glandular Hairs				
5b	6	7	8	9	10	11
		*				
			*			
		*	*			
		*				
*		*			*	
		*			*	
		*				
	*	*				
	*	*				
*	*	*			*	
	*	*				

Species	Petiole														
	Non-Glandular Hairs										Glandular Hairs				
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11	
Section:															
<i>Pelargonium</i>															
<i>P. englerianum</i>	*			*						*	*		*		
<i>P. betulinum</i>	*									*			*		
<i>P. capitatum</i>							*	*		*			*		
<i>P. cordifolium</i>	*						*			*		*	*		
<i>P. crispum</i>	*		*	*						*		*	*		
<i>P. cucullatum</i>	*					*	*		*			*	*		
<i>P. denticulatum</i>					*	*				*	*		*		
<i>P. glutinosum</i>					*						*				
<i>P. hermanniae-</i> <i>folium</i>	*				*					*			*		
<i>P. hispidum</i>	*		*	*					*	*	*		*		
<i>P. papilionaceum</i>				*					*	*	*		*		
<i>P. quercifolium</i>	*			*		*	*		*	*	*		*		
<i>P. radens</i>	*	*			*					*	*		*		
<i>P. ribifolium</i>	*	*			*					*	*		*		
<i>P. scabroide</i>				*	*	*				*	*		*		
<i>P. scabrum</i>	*			*	*	*				*	*	*	*		
<i>P. semitrilobum</i>	*			*	*					*	*		*		
<i>P. sublignosum</i>	*				*					*	*		*		
<i>P. tomentosum</i>			*	*		*	*		*	*			*		
<i>P. vitifolium</i>						*	*	*		*			*		

Species	Lamina														
	Non-Glandular Hairs									Glandular Hairs					
	1a	1b	2a	2b	3	4	5a	5b	6	7	8	9	10	11	
Section:															
<i>Pelargonium</i>															
<i>P. englerianum</i>	*				*					*	*		*		
<i>P. betulinum</i>	*	*			*					*					
<i>P. capitatum</i>			*	*			*	*		*		*	*		
<i>P. cordifolium</i>	*									*					
<i>P. crispum</i>	*				*					*	*		*		
<i>P. cucullatum</i>	*						*			*		*	*		
<i>P. denticulatum</i>					*						*		*		
<i>P. glutinosum</i>					*						*				
<i>P. hermanniae-</i> <i>folium</i>	*				*					*					
<i>P. hispidum</i>	*		*	*						*	*		*		
<i>P. papilionaceum</i>				*						*		*	*		
<i>P. quercifolium</i>	*			*		*	*	*		*			*		
<i>P. radens</i>	*				*					*	*		*		
<i>P. ribifolium</i>	*	*								*			*		
<i>P. scabroide</i>					*					*					
<i>P. scabrum</i>		*			*					*	*		*		
<i>P. semitrilobum</i>	*									*					
<i>P. sublignosum</i>		*			*					*	*		*		
<i>P. tomentosum</i>	*			*			*		*	*			*		
<i>P. vitifolium</i>			*	*			*	*		*		*	*		

DISCUSSION

In the genus *Pelargonium* the indumentum of the leaves is generally of a hirsute to hispid type, with a pilose covering relatively rare and woolliness occurring only in some taxa. Glandular hairs are mostly small, with long glandular hairs occurring more prominently in certain sections. In some cases a specific trichome type is present only in a few species of a section. In such cases it can be used to distinguish between species, e.g. *P. suburbanum* is the only species with curly hairs in the section *Myrrhidium*.

If a specific indumentum type occurs in most of the species of a section, that indumentum type can be regarded as characteristic of the section; e.g., the petioles and laminae of species in the section *Hoarea* are mostly strigose, those in the sections *Pelargonium*, *Glaucophyllum* and *Eumorpha* hispid to setose, in the section *Cortusina* pilose and in the section *Otidia* the indumentum is generally sericeous.

Long glandular hairs occur especially in the sections *Hoarea*, *Ciconium*, *Pelargonium* and *Polyactium*, and are lacking in the sections *Seymouria*,

mina		Glandular Hairs					
5b	6	7	8	9	10	11	
		*	*		*		
*		*			*		
		*		*	*		
		*	*		*		
		*	*	*	*		
			*		*		
		*	*		*		
		*	*	*	*		
		*	*		*		
*		*	*	*	*		
		*	*		*		
	*	*	*	*	*		
*		*	*	*	*		

of the leaves is generally of a relatively rare and woolliness are mostly small, with long in certain sections. In some a few species of a section. In 1 species, e.g. *P. suburbanum* *Myrrhidium*.

st of the species of a section,
acteristic of the section; e.g.,
n *Hoarea* are mostly strigose,
lum and *Eumorpha* hispid to
e section *Otidia* the indumen-

sections *Hoarea*, *Ciconium*,
in the sections *Seymouria*,

Otidia (except *P. carnosum* (L.) L'Hérit.), *Myrrhidium*, *Peristera* (except *P. harveyanum* Schltr. ex Knuth), *Dibrachya* and *Glaucophyllum*. Glandular hairs with pear-shaped heads occur in the sections *Ligularia*, *Jenkinsonia* and *Myrrhidium*. Glandular hairs are completely absent on the leaves of *P. laevigatum* (L.f.) Willd. and *P. lancolatum* (Cav.) Kern. (section *Glaucophyllum*), *P. grandiflorum* (Andr.) Willd. (section *Eumorpha*) and *P. lateripes* L'Hérit. (section *Dibrachya*). In some species of the sections *Polyactium*, *Peristera* and *Glaucophyllum* non-glandular hairs are completely absent and only glandular hairs occur in these cases. In the section *Glaucophyllum* the indumentum type is very conspicuous with only small glandular hairs and characteristic stiff, spiny to bristly non-glandular hairs present. In some species of especially the sections *Polyactium*, *Dibrachya*, *Eumorpha* and *Glaucophyllum*, as well as *P. tetragonum* (L.f.) L'Hérit. (section *Jenkinsonia*) and *P. spathulatum* (And.) DC. (section *Hoarea*), the lamina and/or petiole is glabrous or nearly so. In some sections, i.e. *Polyactium*, *Ligularia*, *Dibrachya*, *Eumorpha*, *Ciconium* and *Pelargonium* the indumentum occurs only, or more densely, in the adaxial groove of the petiole.

CONCLUSIONS

- Due to the fact that in every species the trichome complement consists of a number of characteristic trichome types, and that specific trichome types occur only in certain sections, while in the different species and subspecies of each section the trichomes themselves also differ, trichomes can be of taxonomic value on section, specific and infra-specific level in the genus *Pelargonium*.

Despite the interspecific variation in trichome density, the indumentum type is often characteristic of specific sections (vide DISCUSSION). In the sections the trichome complement consists of certain combinations of trichome types which differ from the combinations found in other sections (Table 1). Within the sections species can also often be grouped together according to their trichome complement. This is probably an indication of a close relationship among these species. In the section *Myrrhidium*, for example, the difference between *P. longicaule* Jacq., *P. myrrhifolium* (L.) L'Hérit. and *P. suburbanum* Clifford, and the interrelationship of their subspecies are clearly reflected in the similar trichome complement of the subspecies of every species. The restriction of glandular hairs with pear-shaped heads to the sections *Ligularia*, *Jenkinsonia* and *Myrrhidium* confirms the presumed relationship of these sections.

The occurrence of a specific trichome type on one organ does not necessarily imply that it occurs on the other organs. The glandular hairs with pear-shaped heads were found on both the petiole and lamina of only

P. ramosissimum (Cav.) Willd. and *P. fragile* (Andr.) Willd. (section *Ligularia*), *P. antidysentericum* (Eckl. & Zeyh.) Kostel. (section *Jenkinsonia*) and *P. myrrhifolium* (L.) L'Hérit. subspecies *myrrhifolium* (section *Myrrhidium*). According to Marais (1980) however, this trichome type occurs on the floral parts of all species in the sections *Jenkinsonia* and *Myrrhidium*, and in the case of *P. tetragonum* (L.f.) L'Hérit. (section *Jenkinsonia*), where it does not occur on the leaf, it is mentioned by Fourie (1978) that this type occurs on the stem.

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